Accumulation of Organic Sunscreen Chemicals in Sharks and Teleost Fishes

Douglas H. Adams[1]*, Ke He[2]*, Ethan Hain[2], Jahir Antonio Batista Andrade[2], Anna Feerick[2], and Lee Blaney[2]

[1]Florida Fish & Wildlife Conservation Commission, Fish & Wildlife Research Institute, Melbourne, FL
[2]University of Maryland Baltimore County, Baltimore, MD

Conclusions

- 1st analysis of sunscreen chemicals (UV-filters) in wild populations of Florida fishes;
- 7 UV-filters were detected in Bonnethead Shark muscle tissue from the Indian River Lagoon (IRL);
- 4-methylbenzylidene-camphor (4MBC) was present at high concentrations in Bonnetheads;
- 6 UV-filters were detected in IRL Red Drum tissue; and,
- Comparatively higher variation in UV filter distribution and concentrations among Red Drum individuals.

Background

- UV-filters have been widely used in sunscreens, pharmaceuticals, food packaging, and textiles;
- UV-filters are likely discharged into the IRL via wastewater effluent and recreational activity; and,
- Some UV-filters are endocrine-disrupting chemicals and can be toxic to corals, fish, and other aquatic organisms.

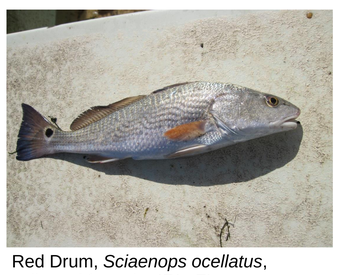
Objectives

- Build, refine, and optimize analytical techniques to measure a wide suite of UV-filters in estuarine fish muscle tissue; and,
- Analyze UV-filter concentrations in a wide array of fish species from the IRL and explore trophic level correlations.

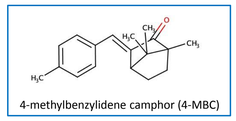
Materials and Methods

- All fish samples were collected from the IRL by the FWC-FWRI's Fisheries-Independent Monitoring Program using 183-m haul seines;
- White dorsal muscle was collected using clean techniques;
- The tissue samples were shipped to UMBC on ice.

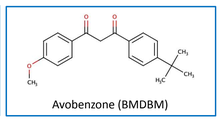
Bonnethead Shark, *Sphyrna tiburo*, collected from the IRL, FL



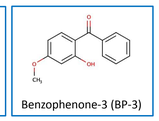
Red Drum, *Sciaenops ocellatus*, collected from the IRL, FL



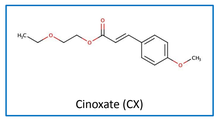
4-methylbenzylidene camphor (4-MBC)



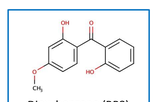
Avobenzone (BMDBM)



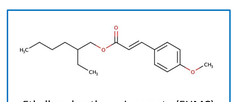
Benzophenone-3 (BP-3)



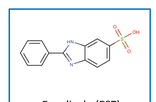
Cinoxate (CX)



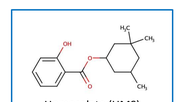
Dioxybenzone (BP8)



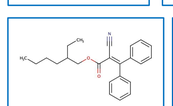
Ethylhexylmethoxycinnamate (EHMC)



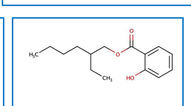
Ensulizole (ESZ)



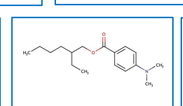
Homosalate (HMS)



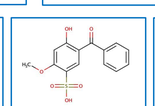
Octocrylene (OC)



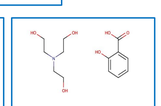
Octisalate (OS)



Padimate O (OD-PABA)

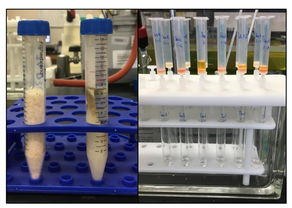


Sulisobenzone (SSB)

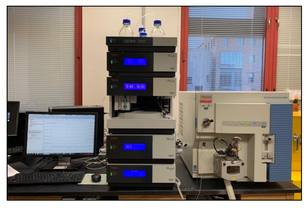


Trolamine salicylate (TEAS)

- In total, 13 UV-filters were investigated in this study;
- Tissue samples were lyophilized and kept in -20 °C;
- Target analytes were extracted with a modified QuEChERS technique and cleaned by a novel reverse-SPE protocol;
- The concentration was determined by LC-MS/MS with mass-labeled surrogates and internal standards; and,
- Full details available in He *et al.*, 2017, *J. Chromatogr. A*

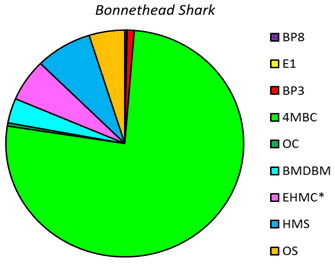


Modified QuEChERS extraction + reverse-SPE clean up

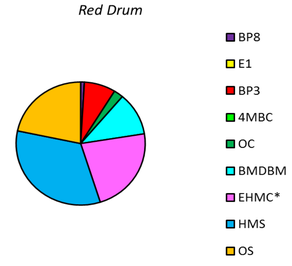


Liquid Chromatography tandem Mass Spectrometry (LC-MS/MS)

Key Findings

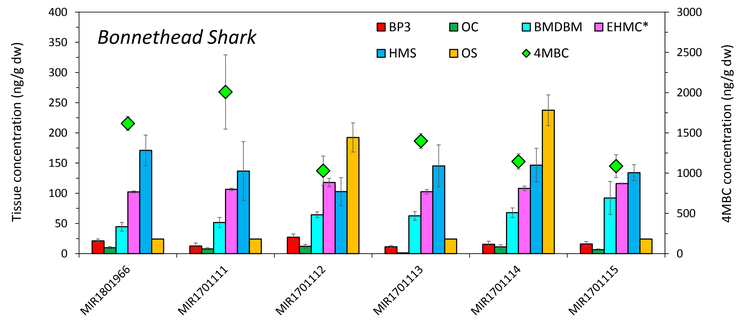


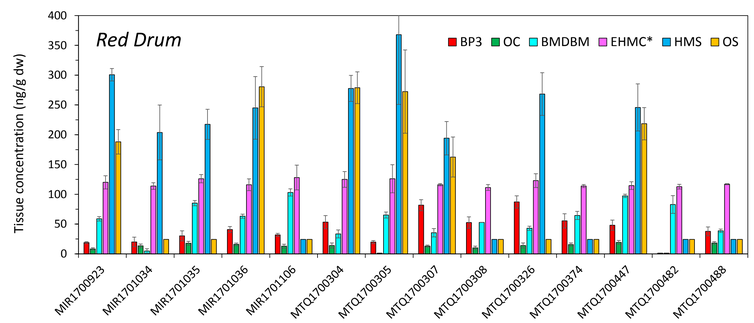
∑ (UV-filters) = 1810 ng g (dw)



∑ (UV-filters) = 525 ng g (dw)

- 4MBC was present at high concentrations in Bonnetheads;
- In general, UV-filter concentrations in Red Drum tissue samples varied more than those in Bonnethead tissue, especially for BP3, BMDBM, and OS; and,
- Feeding ecology and trophic position likely play key roles in this variation.





Distribution and concentrations of UV filters in muscle from Bonnetheads (n=6, 608-913 mm PCL) and Red Drum (n=14, 322-542 mm SL). EHMC* is likely the metabolite of EHMC, but confirmation is needed.

- Bonnetheads have a comparatively restricted prey base (with blue crabs representing a high % of diet), where Red Drum have a more diverse diet and occupy a slightly lower trophic level within the IRL food web; and,
- In general, more hydrophobic UV-filters (*e.g.*, HMS and BMDBM) exhibited higher concentrations in IRL fishes.

Future Research Directions

- Monitor UV-filters in water samples and identify potential sources;
- Expand sampling and analyses of UV-filters to other fish species representing all trophic levels within the IRL to further understand UV filter bioaccumulation within the ecosystem; and,
- Measure UV-filters in different fish organs to inform potential lethal and sub-lethal toxicity mechanisms

Acknowledgements

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